C TRUE BEARINGS

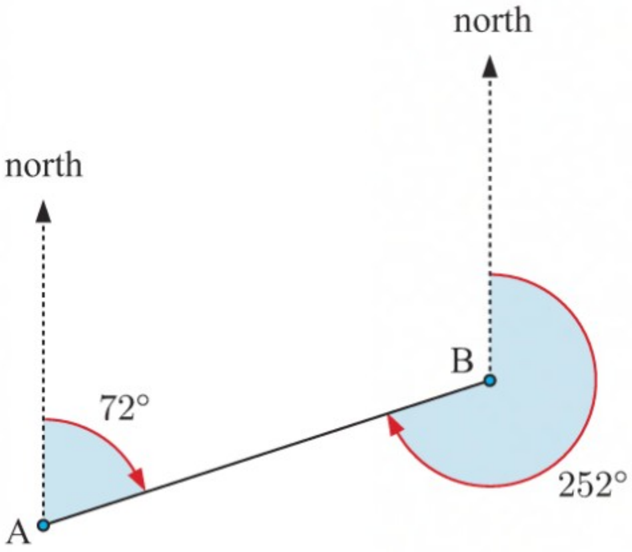
We can describe a direction by comparing it with the **true north direction**. We call this a **true bearing**.

Imagine you are standing at point A, facing north. You turn **clockwise** through an angle until you face B. The **bearing of B from A** is the angle through which you have turned.

So, the bearing of B from A is the clockwise measure of the angle between the 'north' line through A, and [AB].

In the diagram alongside, the bearing of B from A is 72° from true north. We write this as 72°T or 072°.

To find the **bearing of A from B**, we place ourselves at point B, face north, then turn clockwise until we face A. The true bearing of A from B is 252°.



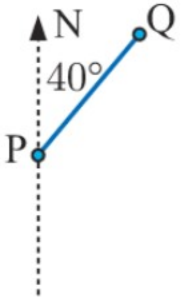
Note:
- A true bearing is always written using three digits. For example, we write 072° rather than 72°.
- The bearing of A from B, and the bearing of B from A, always differ by 180°. You should be able to explain this using angle pair properties for parallel lines.

1 Draw diagrams to represent bearings from O of:

a 136° **b** 240° **c** 051° **d** 327°

2 Write the bearing of Q from P in each diagram:

a



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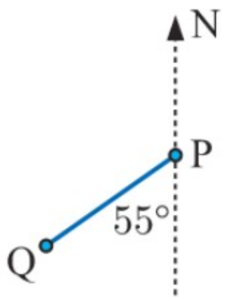

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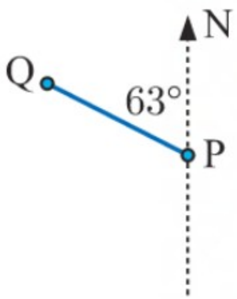

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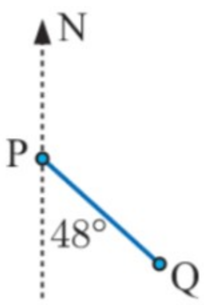
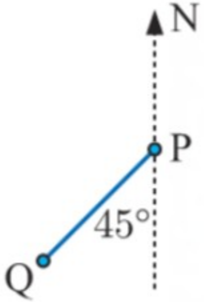
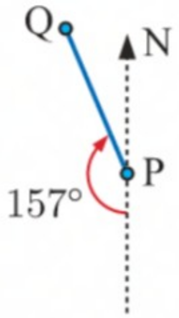


e

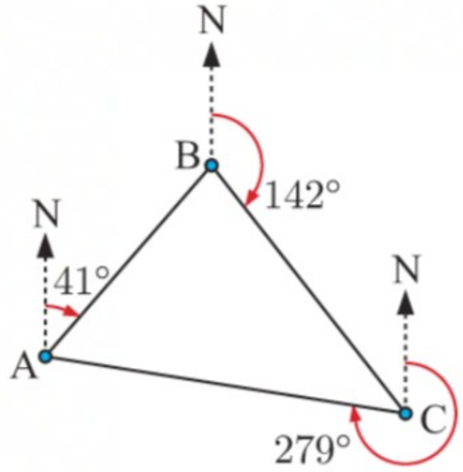


f



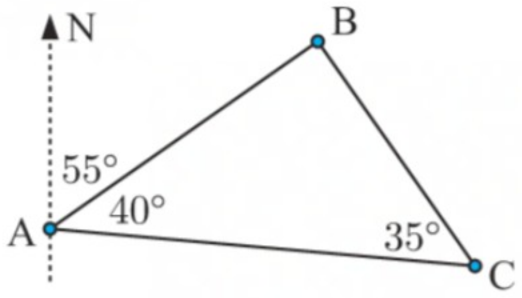
3 A, B, and C are the checkpoints of a triangular orienteering course. Find the bearing of:

a B from A **b** C from B **c** B from C
d C from A **e** A from B **f** A from C.



4 Find the bearing of:

a B from A **b** A from B
c C from A **d** A from C
e C from B **f** B from C.



Example 5 **Self Tutor**

Starting from A, a motorbike travels 7 km east to B, then 3 km south to C.
Find the bearing of C from A.

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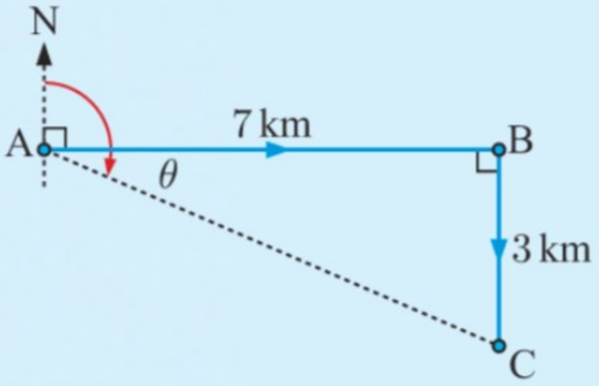
$\tan\theta = \frac{3}{7}$ $\quad\quad \{\tan\theta = \frac{\text{OPP}}{\text{ADJ}}\}$

$\therefore \quad \theta = \tan^{-1}(\frac{3}{7})$

$\therefore \quad \theta \approx 23.2^\circ$

So, the bearing of C from A $\approx 90^\circ + 23.2^\circ$

$\approx 113^\circ$



5 A bush-walker walks 14 km east and then 9 km north. Find the bearing of his finishing point from his starting point.

6 Starting from A, a truck travels 10 km north to B, then 13 km west to C. Find the bearing of C from A.

7 A kayaker paddles due west for 1.5 km. He then turns due south and paddles a further 800 m.

- **a** Draw a diagram of the situation.
- **b** How far is the kayaker from his starting point?
- **c** In what direction must he travel to return to his starting point?

8 Runners A and B leave the same point at the same time. Runner A runs at 10 km h^{-1} due north. Runner B runs at 12 km h^{-1} due east. Find the distance and bearing of runner B from runner A after 30 minutes.

Example 6

Self Tutor

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How far east of the starting position is the rally driver?

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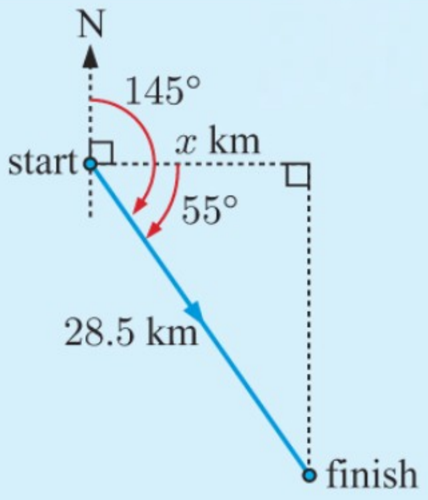

$$\cos 55^\circ = \frac{x}{28.5} \qquad \left\{\cos\theta = \frac{\text{ADJ}}{\text{HYP}}\right\}$$

$$\therefore \quad x = 28.5 \times \cos 55^\circ$$

$$\therefore \quad x \approx 16.3$$

The driver is about 16.3 km east of his starting position.

9 A ship sails for 60 km on a bearing 040°. How far north of its starting point is the ship?

10 An athlete ran for $2\frac{1}{2}$ hours in the direction 164° at a speed of $14\ \text{km}\,\text{h}^{-1}$.

- **a** Draw a fully labelled diagram of the situation.
- **b** Find the distance travelled by the athlete.
- **c** How far **i** east **ii** south of the starting point is the athlete?

11 A hiker walks in the direction 215° and stops when she is 2 km south of her starting point. How far did she walk?

12 An aeroplane travels on a bearing of 295° until it is 200 km west of its starting point. How far has it travelled on this bearing?

Example 7 **Self Tutor**

An aeroplane departs A and flies on a 143° course for 368 km to B. It then changes direction to a 233° course and flies a further 472 km to C. Find:

a the distance of C from A

b the bearing of C from A.

Example 7

Self Tutor

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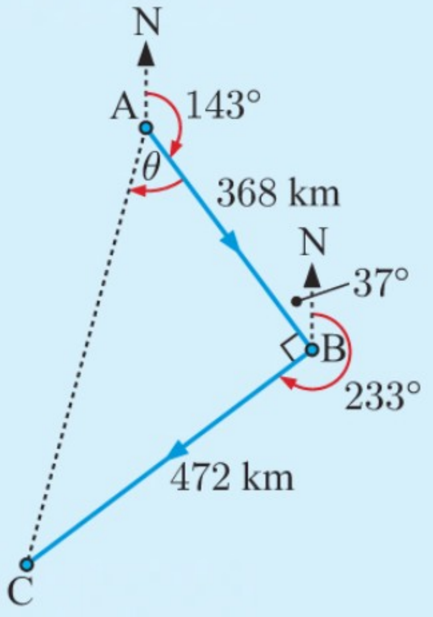


$A\hat{B}N = 180° - 143° = 37°$ {co-interior angles}

$\therefore\ A\hat{B}C = 360° - 37° - 233°$

$= 90°$ {angles at a point}

a $AC^2 = 368^2 + 472^2$ {Pythagoras}

$\therefore\ AC = \sqrt{368^2 + 472^2}$ {as $AC > 0$}

≈ 598.5

So, C is about 598.5 km from A.

b To find the bearing of C from A, we first need to find θ.

Now $\tan\theta = \dfrac{472}{368}$ $\left\{\tan\theta = \dfrac{\text{OPP}}{\text{ADJ}}\right\}$

$\therefore\ \theta = \tan^{-1}\left(\frac{472}{368}\right)$

$\therefore\ \theta \approx 52.1°$

The bearing of C from A is $143° + 52.1° \approx 195°$.

In some bearings problems we use the properties of parallel lines to find angles.

13 A cyclist departs point R and rides on a straight road for 2.3 km in the direction 197°. She then changes direction and rides for 1.8 km in the direction 107° to point S.

a Draw a fully labelled sketch of this situation.

b Find the distance between R and S.

c Find the bearing of S from R.

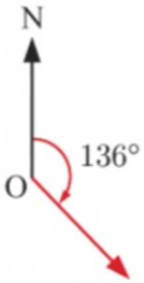
14 An orienteering competitor travels 3 km in the direction 024°, and then 2 km in the direction 114°. Find the distance and bearing of the finishing point from the starting point.

15 A fishing trawler sails from port P in the direction 313° for 10 km, and then in the direction 043° for 32 km.
Calculate:

a the distance and bearing of the trawler from P

b the direction in which the trawler must sail in order to return to P.

1 **a**



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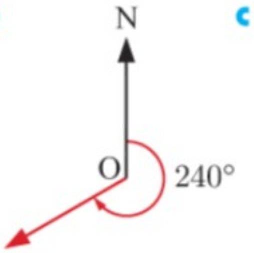

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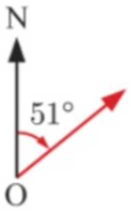

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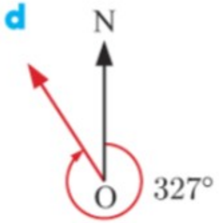


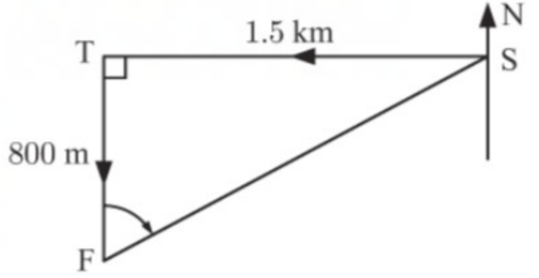
2 **a** 040° **b** 235° **c** 297° **d** 132° **e** 225°
f 337°

3 **a** 041° **b** 142° **c** 322° **d** 099° **e** 221°
f 279°

4 **a** 055° **b** 235° **c** 095° **d** 275° **e** 130°
f 310°

5 ≈ 057.3° **6** ≈ 308°

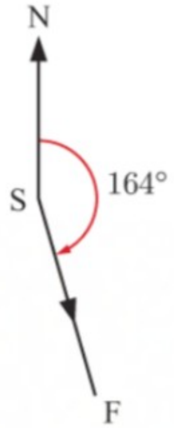
7 **a**



b 1.7 km
c 061.9°T

8 ≈ 7.81 km, ≈ 130° **9** ≈ 46.0 km

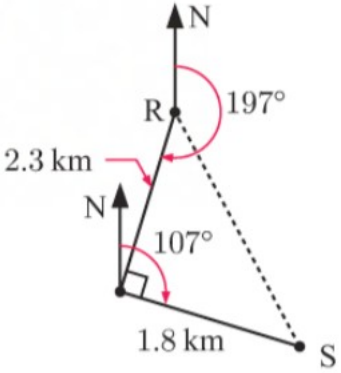
10 **a**



b 35 km
c **i** ≈ 9.65 km
ii ≈ 33.6 km

11 ≈ 2.44 km **12** ≈ 221 km

13 **a**



b 2.92 km

c 159°

14 ≈ 3.61 km, ≈ 057.7°

15 **a** ≈ 33.5 km, ≈ 025.6° **b** ≈ 206°